UNITED STATES DEPARTMENT OF AGRICULTURE
Agricultural Research Service

WINNING THE WAR AGAINST INSECTS*

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INSECTS NEVER TIRE in their ceaseless battle against man over the inheritance of the earth. Recently scientists have come up with some startling new weapons for farmers to use in this elemental struggle for survival.

Here are some examples:

Treated cotton seeds are growing into plants that actually bite back at the insects. The plants have a built-in insecticide. This year, cotton growers lucky enough to get some of the chemically treated seed achieved early season insect control without so much as hitching up the sprayer or duster.

In the Midwest, up-to-date farmers are growing varieties of wheat with a built-in, genetic resistance to that pest, the Hessian fly.

Out West, specialists are using a new technique to put a stopper on the khapra beetle, one of the biggest insect threats ever to reach our shores. Warehouses filled with stored grains and seed--and khapra beetles--are swathed in as much as 9 1/2 acres of gas-tight plastic, and then fumigated.

Eastern homeowners are actually spreading a contagious disease to kill off Japanese beetle grubs. They are dotting their lawns with disease spores which spread death only to Japanese beetle larvae and certain other white grubs. There's an epidemic, and the Japanese beetle disappears.

Controls for Most Insects

If you could line up the more than 10,000 insect pests of the United States, you could jot down a control measure for nearly every kind. A hundred years ago, our forefathers would have been hard put to control a tenth of them. That is one way to measure progress in our fight against pests.

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* From Popular Mechanics Magazine, December 1956.

The fantastic ability of insects to reproduce and their equally fantastic capacity for survival are two of the reasons that our successes against them seldom represent total victory. Here in the United States, insects still destroy an estimated $4,000,000,000 worth of our agricultural production each year.

Nor is there much that is spectacular underlying the successes. Victory usually comes from study, hard work and try-and-try again.

Responsibility for finding ways of controlling insects falls on the entomologist--the insect scientist--but the total struggle frequently involves chemists, engineers, plant and livestock authorities, the government, industry and farmers. Success often requires the teamwork of all of these. An example is the case of the European corn borer, our number-one corn pest.

There was hardly a stir among farmers when in 1917 the corn borer was discovered for the first time near Boston. But as the pest gained a foothold and began to move in on the Corn Belt the need for "doing something" became obvious.

Beginning to do something meant learning about the insect, for then as now, effective control methods were built upon a knowledge of the pest--how it lives, reproduces and adjusts to environment.

For example, our scientists found that borers spent the winter in the stalks and other remnants of corn harvest left in the field; that if these stalks were burned or buried deep enough the borers could not survive the winter, and their life cycle would be broken. This bit of knowledge was the key to a U.S. Department of Agriculture quarantine levied against the corn borer in 1927. Stalk clean-up by burning and deep plowing slowed the spread of the insect, but not well enough some believed to warrant the cost of the program. The quarantine was lifted in 1933. The corn borer quickly spread across the Corn Belt.

No Natural Enemies

Research continued and our scientists discovered a primary reason for the borers' unusual ability to develop huge populations in American cornfields. The borer had arrived in the United States unattended--it had left its natural enemies on the other side of the Atlantic. In 1920 scientists of the Department of Agriculture began a search that lasted for two decades and resulted in the successful introduction from Europe of several parasitic flies

and wasps that prey upon the borer. Today these beneficial insects, working practically unnoticed in our cornfields, are proving quite successful in holding down borer infestations in the eastern States, and effecting limited but growing control of borers in the Corn Belt.

In further evidence of the value of basic knowledge: Modern control methods in general use by Corn Belt farmers take into account the fact that throughout the Midwest there are two broods of the borer each growing season. The first brood feeds in the leaf whorls and on the silks and ears; the second tunnels into the stalks and ear shanks of maturing corn. Entomologists have searched out corn plants that inherently discourage leaf feeding by the first brood borers. They have found other plants with enough stalk strength to withstand tunneling by the second brood. It is reasonable to expect that one day varieties of corn highly resistant to attack by the corn borer will be widely grown in this country.

Corn strains with these resistance characteristics are being combined into high-yielding commercial hybrids. Chemists have developed certain chemicals into highly effective borer-killing insecticides to knock out the first brood before it begins feeding; engineers have developed high-clearance machines that deliver sprays into the leaf whorls of young plants without mechanical damage to the crop. This year farmers are using a new weapon --DDT granules--that they can sift into the leaf whorls from a rig that looks like a grain drill on stilts.

The corn-borer story serves to illustrate that despite our achievements with methods, materials and machines we can only insure our well-being in the face of such menacing pests by constantly searching for better weapons and by the farmer's effective use of those weapons.

Now let's take a more analytical look at our original "success" stories about cotton insects, the Hessian fly, and the khapra and Japanese beetles.

Thimet, developed by the American Cyanamid Company, is a systemic insecticide that "bites back". It is one of the newest and perhaps the most powerful single weapon ever directed against cotton pests. Unlike other cotton insecticides, Thimet is not sprayed or dusted upon the growing cotton. Instead, seed is treated with the chemical, usually by seed suppliers. An organic phosphate, Thimet is absorbed into the seed and grows up with the plant. Thus, being in the "system" of the plant, rather than a surface veneer of spray or dust, Thimet does no harm to beneficial insects, cannot be washed away by rain. But for nine weeks or more, plants sprouting from the seed so

treated will kill thrips, aphids and mites. It has even proved lethal to the boll weevil when he moves into the field before Thimet's killing power wanes.

The Hessian fly is an old-timer--and a long-time enemy of the man who grows wheat and barley. It is believed to have reached the United States in 1776 on the bedding straw of Hessian soldiers.

Farmers throughout the winter-wheat belt annually save themselves about $60,000,000 by carefully following two simple but fundamental, practices: They seed their wheat late enough in the fall so that the autumn generation of flies is denied green sprouting grain upon which to lay eggs; they plant varieties of wheat of a genetic make-up that resists feeding by the fly.

The khapra beetle, an "inside" insect that attacks stored grains and seeds, is a newcomer to the United States. It was first discovered in a warehouse in Tulare County, Calif., in 1953. The khapra beetle is so tiny that it can hide in cracks that insecticide sprays won't penetrate; so prolific that a single pair can produce literally millions of offspring in a period of six to eight months; so destructive that it could become America's worst stored-grain pest. Unlike the casual reception given the corn borer, State and Federal officials moved in rapidly on this insect. They carried out a survey to define the limits of infestation and established a quarantine to prevent further spread. They have pinned it down to some 410 grain and seed storage structures in Arizona, California, New Mexico, and adjacent areas of the Republic of Mexico.

Scientists found that the beetle could be killed with a high-powered fumigant, methyl bromide. But how was a gas of this kind to be distributed evenly throughout a tremendous storage building? All it required, they found, was enough fumigant, enough gas-tight plastic and adequate means of circulating or distributing the gas within the enclosure. Made-to-order nylon plastic tarps, clamped together with air-tight seams, are spread over acres of buildings, then fans circulate tons of fumigant. In 48 hours the job is done. So far, these teams have eradicated the beetle from 68,055,203 of the 108,737,000 cubic feet of storage found to be infested.

Most Annoying Pest

If you are not acquainted with the Jap beetle, you probably live where it doesn't. It's hard to imagine a more annoying, more destructive pest.

Throughout eastern United States where it currently operates at a cost to inhabitants of several million dollars a year, the beetle makes visible and violent trouble from May through September. It has a taste for 275 different plants, takes pernicious pleasure in spattering a line of fresh wash and can panic the most steely nerved man by slipping inside his collar. When the beetle isn't winging about it is below ground in the form of a white grub gorging on the roots of lawn grasses.

Shortly after the beetle was found in the United States--in 1916 at Riverton, N. J.--its eradication was attempted, but because of the inadequacy of controls available at the time, failed. It has been under Federal and State quarantine continuously--a program of commodity and vehicular inspection has slowed its progress so that today the infestation is confined to the East. It is surprising that the spread has not been much more rapid, because the Jap beetle is a great hitchhiker. The grubs can be moved about in the soil on the roots of plants; the adults ride in cars, trucks, trains, buses and airplanes. Quarantine inspectors keep close tabs on airports and frequently, by quick action, wipe out infestations at or near these points.

Scientists meanwhile have had marked success in developing ways of controlling this pest. They have imported from Japan wasps that parasitize the beetles; they have found DDT and methoxychlor sprays and dusts effective against the adults. A half dozen organic insecticides washed into the soil will kill the grubs. Most remarkable, however, has been the development of the so-called milky disease as a control. USDA entomologists found that they could exploit a weakness in the make-up of the beetle: its susceptibility to a spore-forming fungus. They learned how to obtain large quantities of disease spores by artificially infecting insects, then after proper incubation grinding the bodies and mixing the resulting product with a suitable dust carrier. A spot of spore dust every two or three feet on the lawn will penetrate into the soil and slowly but surely kill off the grubs beneath. Once there, it will kill as long as there are grubs for it to attack.

The success with milky disease has set scientists hot on the trail of other diseases for use against other insects. In the Southwest, growers can control the alfalfa caterpillar by treating it to a virus disease applied with field sprayer or by plane. In preliminary studies, diseases have shown great promise against such forest insects as the European and Virginia pine sawflies; against our chief orchard pest the codling moth, and against several important insect pests of vegetables and corn. One big advantage of spreading bug diseases over using insecticides: The diseases offer control without danger to man and animals.

Still other weapons that entomologists have found useful against insects include materials that attract and materials that repel the pests, and atomic energy.

Baits for Insects

Attractants are not a new idea (grandfather used poisoned baits to control cockroaches), but they are getting new emphasis. Fly baits--generally a mixture of insecticide and sweetening--are in use on dairy and poultry farms and at city dumps and other urban locations where flies breed. Attractants are proving a key weapon in the all-out effort to eradicate the recently discovered Florida infestation of the Mediterranean fruit fly. There, two attractants are in use--a hydrolyzed protein that is particularly attractive to the female flies, and oil of angelica, an ingredient of perfumes and liqueurs that draws the males.

At the other extreme are the chemicals that keep the bugs at bay. There are several good mosquito repellents on sale at the drugstore, but none that compares with a USDA-developed chemical now under test by our armed forces. This repellent, which can be rubbed on exposed parts of the body or impregnated into clothing, not only repels six species of mosquitoes, but does so two to three times longer than standard repellents. It also repels chiggers, ticks, fleas, deer flies and stable flies.

The use of radioactive tracers that measure the flight of insects or the movement of insecticides within an insect, a plant or an animal, has become a useful research tool. In at least one instance, however, atomic energy has had direct application in insect control.

Since 1933 when the screw worm, a vicious attacker of livestock, was inadvertently established in the Southeast by a shipment of infested cattle from the West into Florida, entomologists have been seeking some way to eradicate it--and thus end its annual $10,000,000 tax on the livestock industry. Atomic energy may supply the answer. Study showed the scientists that exposing male screw-worm flies to radioactivity (gamma rays from radioactive cobalt) would make them sexually sterile, but otherwise would not affect their normal activity. They found too, that female flies would readily mate with the sterile males, but would produce only infertile eggs. Why then, USDA scientists reasoned, could not great numbers of male flies be sterilized and released to infiltrate the natural screw-worm population?

Theoretically, one release would reduce the number of fertile eggs deposited in proportion to the ratio of the number of sterile to normal males. If there were 10 times as many sterile as normal males, one tenth as many fertile eggs would result. A second release would cut even deeper into the natural population, and eventually, after enough releases, the natural population would no longer exist.

Two years ago, USDA entomologists, with the consent and encouragement of the Dutch Government, tried out this theory on the screw-worm-infested West Indies island of Curacao. Releasing the sterile males at the rate of 400 per square mile at twice-a-week intervals, they accomplished eradication within four months. They are now drawing up plans to attempt the eradication of the screw worm from southeastern United States.

Whether it be atomic energy or deep plowing, entomologists overlook no bet in insect control. Generally, though, they depend upon insecticides as their chief weapon.

A great deal has been written about the chemical revolution in insect control that began with the development of DDT during World War II. Since then more than a score of powerful organic chemicals have bolstered man's insect-fighting arsenal. One is aldrin, a chlorinated hydrocarbon that has been responsible for fantastically effective control of grasshoppers. As little as two ounces of the insecticide has killed millions of these pests.

Today, Americans are fighting insects at a cost of hundreds of millions of dollars each year. They are spending additional millions for entomological research and for large-scale insect-control programs.

Tomorrow, the cost may be even greater if we wish our high standard of living to continue or improve. Our growing population, our increasing world responsibilities, and our limited and gradually diminishing natural resources force us into ever-greater competition with insects for our food, our possessions, and our health. There is no doubt that man will ultimately --perhaps completely--triumph, but remaining uncharted courses are many --and there must be no relaxation in our efforts.